US009109670B2

(12) **United States Patent**
Roehm et al.

(10) **Patent No.: US 9,109,670 B2**
(45) **Date of Patent: Aug. 18, 2015**

(54) **HANDHELD POWER TOOL HAVING A REDUCTION GEAR UNIT**

(75) Inventors: **Heiko Roehm**, Stuttgart (DE); **Ralf Windsheimer**, Stuttgart (DE)

(73) Assignee: **ROBERT BOSCH GMBH**, Stuttgart (DE)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 52 days.

(21) Appl. No.: **13/985,513**

(22) PCT Filed: **Feb. 1, 2012**

(86) PCT No.: **PCT/EP2012/051685**
§ 371 (c)(1), (2), (4) Date: **Oct. 24, 2013**

(87) PCT Pub. No.: **WO2012/110321**
PCT Pub. Date: **Aug. 23, 2012**

(65) **Prior Publication Data**

US 2014/0051539 A1 Feb. 20, 2014

(30) **Foreign Application Priority Data**

Feb. 15, 2011 (DE) 10 2011 004 126

(51) **Int. Cl.**
F16H 3/62 (2006.01)
B25F 5/00 (2006.01)
F16D 7/00 (2006.01)

(52) **U.S. Cl.**
CPC ***F16H 3/62*** (2013.01); ***B25F 5/001*** (2013.01); ***F16D 7/00*** (2013.01)

(58) **Field of Classification Search**
CPC F16H 3/62; F16D 7/00; B25F 5/001
USPC 475/298, 299, 263, 264, 265; 81/464; 173/47, 216, 217
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,764,272 A * 9/1956 Reynolds 192/150
4,528,470 A * 7/1985 Young et al. 310/78
5,339,908 A * 8/1994 Yokota et al. 173/216
6,796,921 B1 9/2004 Buck et al.
7,730,964 B2 6/2010 Simm et al.

(Continued)

FOREIGN PATENT DOCUMENTS

CN 1519080 8/2004
CN 101242935 8/2008

(Continued)

OTHER PUBLICATIONS

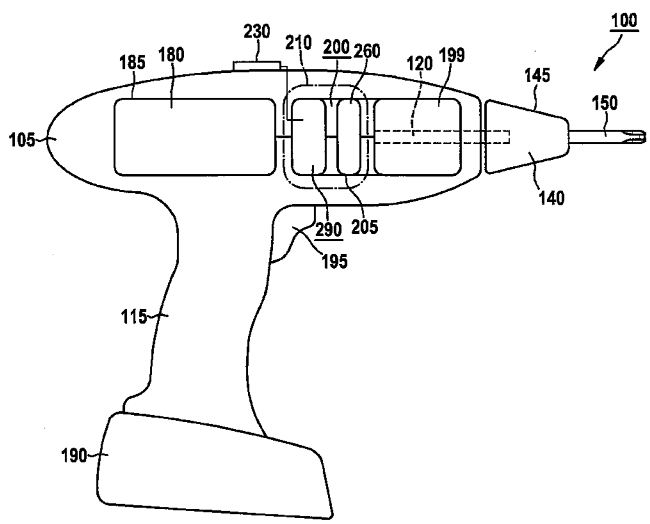
International Search Report, PCT International Application No. PCT/EP2012/051685, dated Jul. 13, 2012.

Primary Examiner — Roger Pang
(74) *Attorney, Agent, or Firm* — Kenyon & Kenyon LLP

(57) **ABSTRACT**

In a handheld power tool having a reduction gear unit, drivable by a motor, for driving a drive shaft, the reduction gear unit being situated in a gear housing and being shiftable via a gearshift at least between a first gear having a comparatively high torque and a second gear having a comparatively low torque, the reduction gear unit is assigned a mechanical overload protection device which is designed to limit the reduction gear unit during operation of the handheld power tool, if a torque, transferred from the drive shaft to the reduction gear unit, exceeds a machine-specific limiting value.

8 Claims, 4 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2006/0068968	A1*	3/2006	Eisenhardt	475/299
2006/0287157	A1*	12/2006	Katoh et al.	475/263
2007/0023196	A1	2/2007	Hara et al.	
2007/0114050	A1*	5/2007	Baumann et al.	173/216
2008/0173459	A1*	7/2008	Kuroyanagi et al.	173/216
2010/0236805	A1*	9/2010	Saur	173/216
2011/0017484	A1*	1/2011	Roehm	173/178
2011/0147029	A1*	6/2011	Roehm et al.	173/176
2011/0220377	A1*	9/2011	Roehm	173/47
2013/0025899	A1*	1/2013	Kuehne	173/216
2013/0267374	A1*	10/2013	Blum et al.	475/299
2014/0174775	A1*	6/2014	Parks	173/47

FOREIGN PATENT DOCUMENTS

DE	2936993	4/1981
DE	20 2004 004 749	9/2005
DE	10 2005 037 254	2/2007
EP	1 946 895	7/2008
GB	2 058 253	4/1981

* cited by examiner

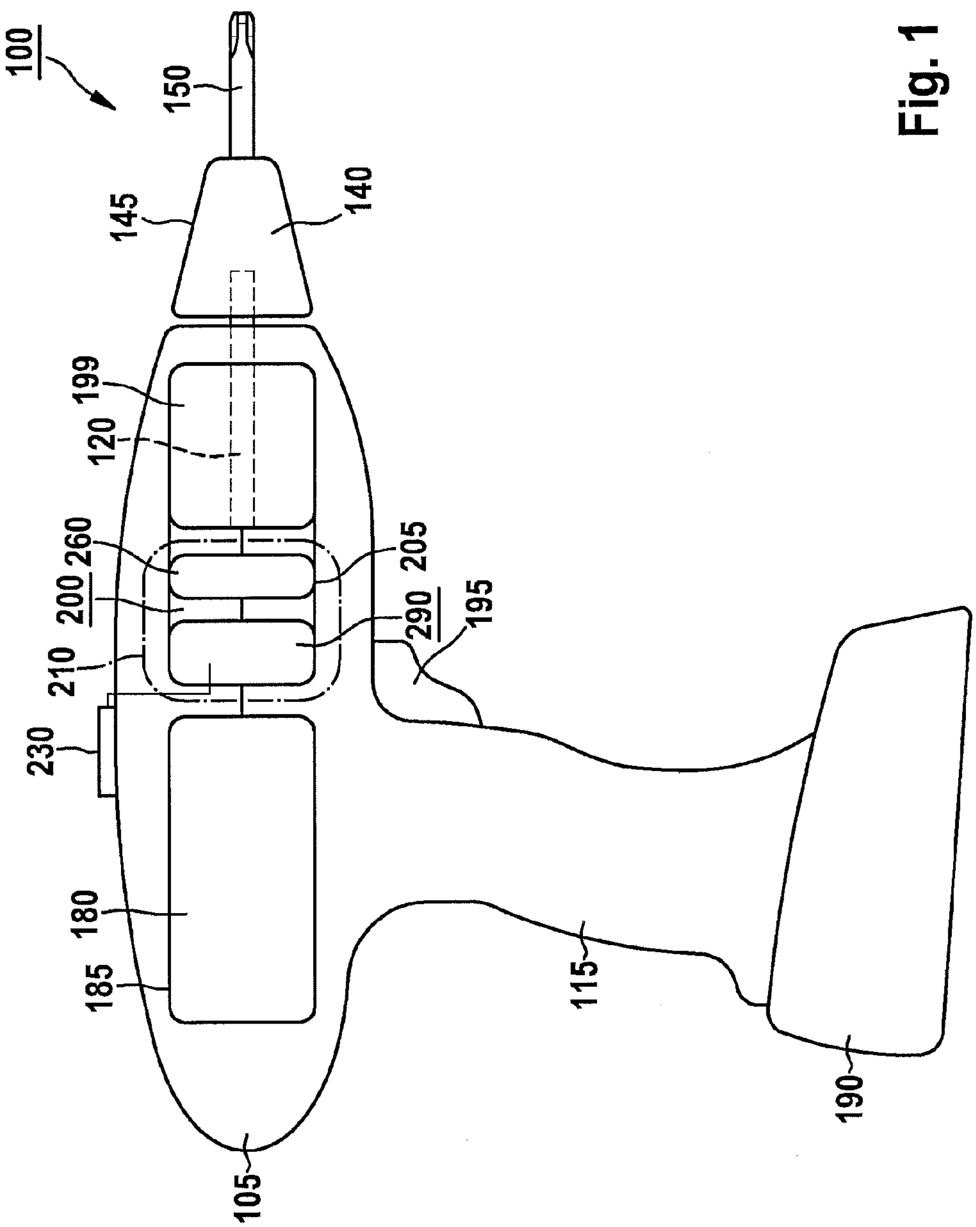

100
150
145
140
199
120
260
200
205
210
290
195
230
180
185
115
190
105

Fig. 1

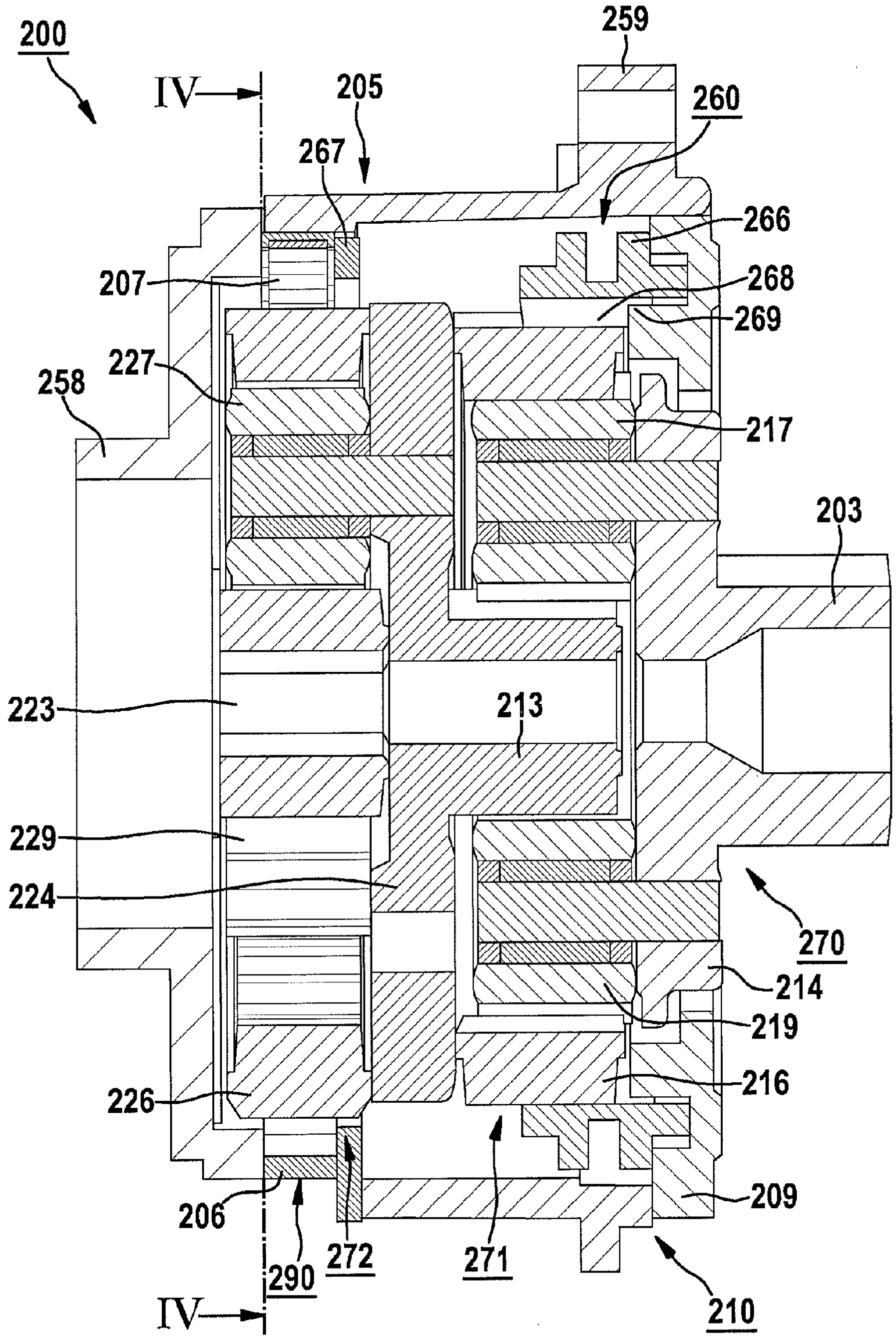

200
IV
205
267
259
260
266
268
269
207
227
258
217
203
223
213
229
224
270
214
219
226
216
209
206
290
272
271
210
IV

Fig. 2

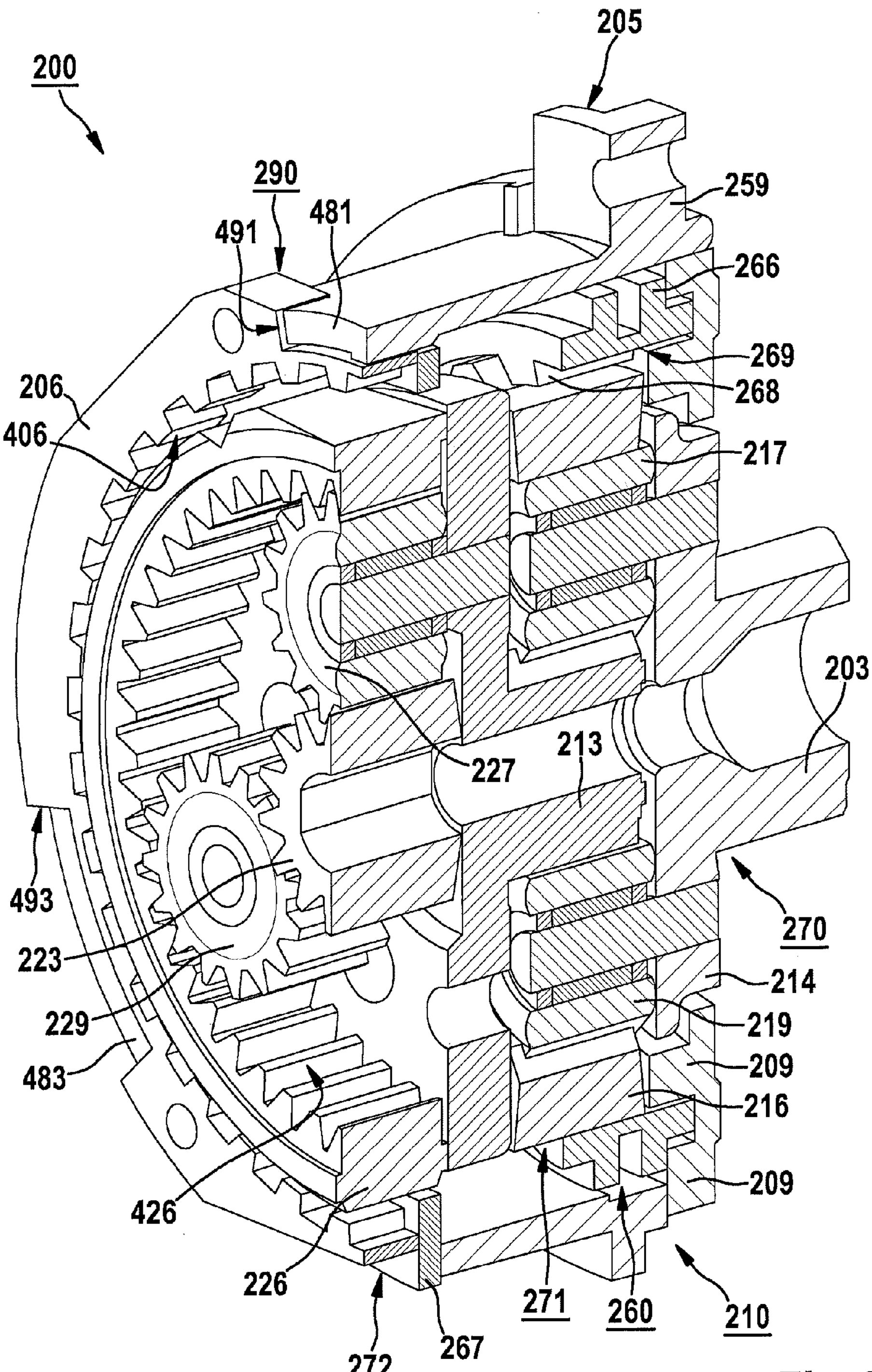

200
205
290
491
481
259
266
269
268
206
406
217
203
227
213
493
270
223
214
229
219
483
209
216
426
209
226
271
260
210
272
267

Fig. 3

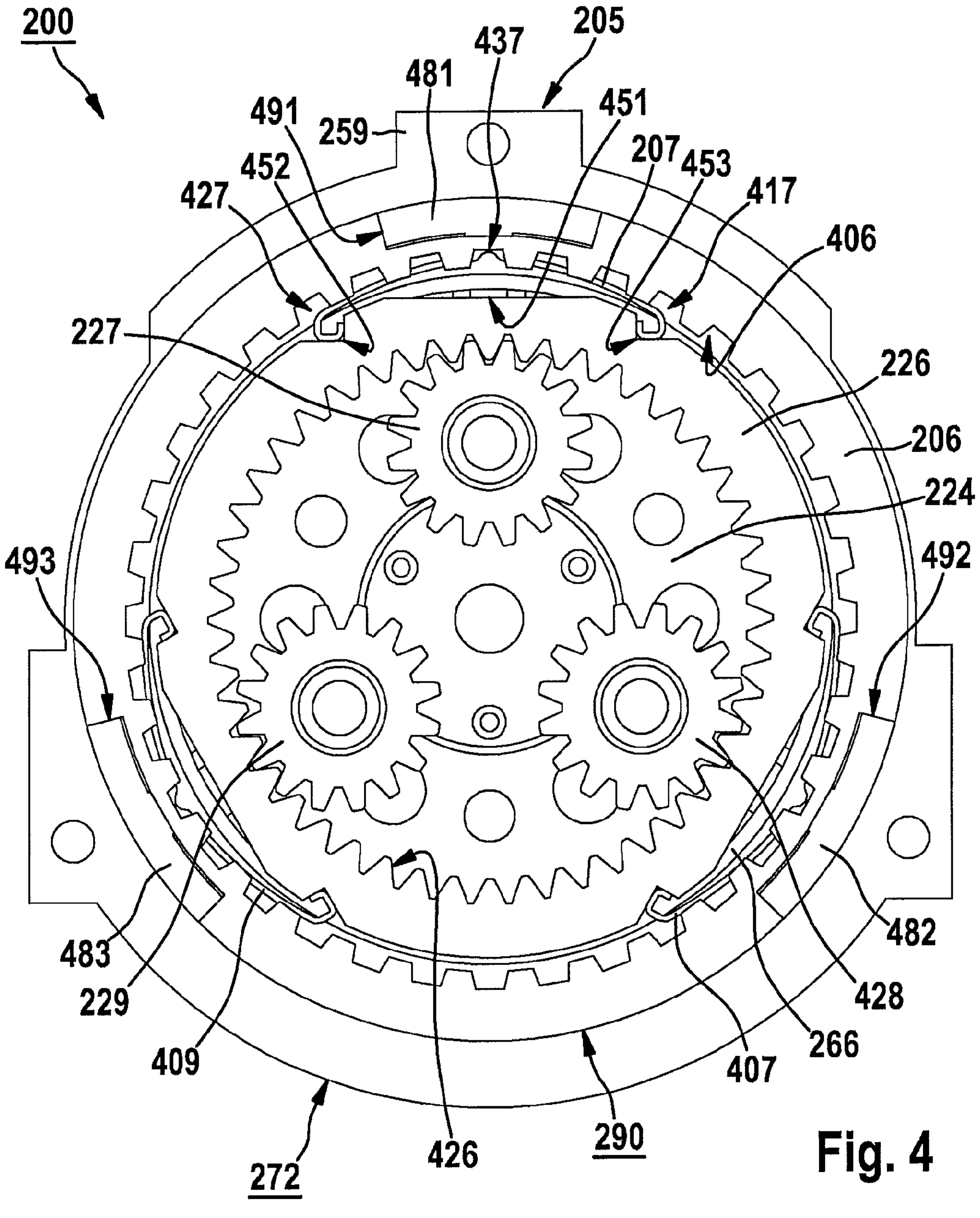

200
205
437
481
451
491
259
207
453
452
417
427
406
227
226
206
224
493
492
483
482
229
428
409
266
407
426
290
272

Fig. 4

HANDHELD POWER TOOL HAVING A REDUCTION GEAR UNIT

FIELD

The present invention relates to a handheld power tool having a reduction gear unit, drivable by a motor, for driving a drive shaft, the reduction gear unit being situated in a gear housing and being shiftable via a gearshift at least between a first gear having a comparatively high torque and a second gear having a comparatively low torque.

BACKGROUND INFORMATION

Such handheld power tools often have a reduction gear unit for driving a drive shaft, using which a predefined motor speed may be reduced to a speed range of the drive shaft which is necessary for a particular application. For example, motor speeds of approximately 20,000 RPM are reduced to a speed range of approximately 150 RPM to 2,000 RPM in cordless screwdrivers, cordless combi drills, and/or cordless percussion drills. The reduction gear units are, for example, designed as multistage planetary gear sets having at least two gears, so that a user of such a handheld power tool is, for example, able to shift this handheld power tool between a first, slower, gear having a comparatively high torque and a second, faster, gear having a comparatively low torque. Moreover, the reduction gear unit may be assigned a torque clutch using which it is possible to prevent the drive shaft from being driven by the reduction gear unit during operation of the handheld power tool, if a torque, transferred from the drive shaft to the reduction gear unit, exceeds a threshold value settable by a user.

The disadvantage of the above-described power drills is that in the case of cordless combi drills, the torque clutch or a clutch functionality provided by the torque clutch is deactivated in the drilling mode, thus setting the threshold value settable by the user virtually to "infinitely." If, however, the cordless combi drill set to the drilling mode is used for screwing, a kinetic energy of rotation conveyed to the drive shaft may be converted into a rotation of the cordless combi drill or a tool housing assigned thereto, for example, in the event of so-called hard screw applications which may occur during metal screw fittings, for example, and may cause a spontaneous blocking of the drive shaft. This may result in an impact-like load on components of a drive train assigned to the cordless combi drill and in a failure of the components of the drive train involved.

SUMMARY

One object of the present invention is to provide a handheld power tool during operation of which a conveyance of a comparatively high kinetic energy of rotation to an assigned tool housing via the drive shaft of this handheld power tool may be at least limited independently of a set operating mode.

In accordance with the present invention, an example handheld power tool is provided having a reduction gear unit, drivable by a motor, for driving a drive shaft. The reduction gear unit is situated in a gear housing and is shiftable via a gearshift between a first gear having a comparatively high torque and a second gear having a comparatively low torque. The reduction gear unit is assigned a mechanical overload protection device which is designed to limit the reduction gear unit during operation of the handheld power tool, if a torque, transferred from the drive shaft to the reduction gear unit, exceeds a machine-specific limiting value.

The present invention thus makes possible the provision of a handheld power tool during whose operation a conveyance of excessive kinetic energy of rotation to the tool housing, assigned to the handheld power tool, via the drive shaft of the handheld power tool may be effectively and reliably prevented.

According to one specific embodiment, the reduction gear unit is assigned a torque clutch which is designed to prevent the drive shaft from being driven by the reduction gear unit during operation of the handheld power tool, if a torque, transferred from the drive shaft to the reduction gear unit, exceeds a threshold value settable by a user of the handheld power tool. The machine-specific limiting value is preferably greater than a maximum threshold value settable by the user of the handheld power tool.

In this way, a handheld power tool may be made available in a simple manner which, on the one hand, is protected by the machine-specific overload protection from a comparatively high torque, which is predefined independently of a user, being transferred from the drive shaft to the tool housing, and, on the other hand, may be protected by a torque clutch, operable by a user, from a comparatively low torque being transferred which is settable by the user at least within predefined limits.

According to one specific embodiment, the reduction gear unit is designed in the form of a planetary gear set having at least three planetary stages. The overload protection device is preferably assigned to a planetary stage which is not directly connected to either the gearshift or the torque clutch.

The present invention thus allows the provision of a solid and small reduction gear unit having a robust overload protection device.

The planetary stage to which the overload protection device is assigned preferably faces the motor.

This makes it possible to design the overload protection device in a simple manner on the planetary gear set.

The planetary stage to which the overload protection device is assigned preferably has an annulus gear which is coupled to the gear housing via at least one latching spring element.

In this way, an uncomplicated and cost-effective overload protection device may be provided.

According to one specific embodiment, the annulus gear is rotatably fixedly situated in the gear housing until the machine-specific limiting value is reached for the case that a torque is transferred from the drive shaft to the reduction gear unit and is able to rotate in the gear housing around a longitudinal axis assigned to the drive shaft if the machine-specific limiting value is exceeded.

The present invention thus makes possible the provision of a safe and reliable overload protection device.

The at least one latching spring element is preferably situated resiliently on the annulus gear in the radially outward direction. Alternatively thereto, the at least one latching spring element may act resiliently against the annulus gear in the radially inward direction.

In this way, a simple and robust overload protection device may be provided.

According to one specific embodiment, a latching element, which is rotatably fixedly connected to the gear housing, is provided in the radial direction between the annulus gear and the gear housing.

The present invention thus allows the latching spring element to latch solidly and directly with the gear housing during normal operation of the handheld power tool.

In accordance with the present invention, a mechanical overload protection device is provided for a handheld power tool which has a reduction gear unit, drivable by a motor, for driving a drive shaft, the reduction gear unit being situated in a gear housing and being shiftable via a gearshift at least between a first gear having a comparatively high torque and a second gear having a comparatively low torque. The overload protection device is designed to limit the reduction gear unit during operation of the handheld power tool, if a torque, transferred from the drive shaft to the reduction gear unit, exceeds a machine-specific limiting value.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is explained in greater detail below with reference to exemplary embodiments.

FIG. **1** shows a schematic view of a handheld power tool according to one specific embodiment.

FIG. **2** shows an enlarged sectional view of a detail of the handheld power tool from FIG. **1**.

FIG. **3** shows a perspective view of a detail of the handheld power tool from FIG. **1**.

FIG. **4** shows a section view of the handheld power tool from FIG. **1**, viewed along a line IV-IV from FIG. **2**.

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

FIG. **1** shows an exemplary handheld power tool **100** which has a tool housing **105** including a handle **115**. According to one specific embodiment, handheld power tool **100** is connectable mechanically and electrically to a battery pack **190** for a mains-independent power supply. In FIG. **1**, handheld power tool **100** is designed as a cordless combi drill as an example. It is, however, pointed out that the present invention is not limited to cordless combi drills, but may also be used with various handheld power tools in which a tool is set into rotation regardless of whether the handheld power tool is mains-operable or operable mains-independently using battery pack **190**, e.g., with a screwdriver or a cordless screwdriver, a percussion drill, or a cordless percussion drill, etc.

An electric drive motor **180**, which is supplied with current by battery pack **190**, and a gear unit **200** are situated in tool housing **105**. Drive motor **180** is connected to a drive shaft **120**, e.g., a drive spindle, via gear unit **200**. Drive motor **180** is illustratively situated in a motor housing **185** and gear unit **200** in a gear housing **205**, gear housing **205** and motor housing **185** being situated in tool housing **105** as an example. A tool holder **140**, which has a drill chuck **145** as an example, is assigned to gear unit **200**. This tool holder **140** is used to hold a tool **150** and may be integrally connected to drive shaft **120** drivable by drive motor **180** via gear unit **200**, or may be connected to it in the form of an attachment.

Drive motor **180** is, for example, operable via a manual switch **195**, i.e., may be switched on and off, and may be any type of motor, e.g., an electronically commutated motor or a DC motor. Preferably, drive motor **180** may be controlled or regulated electronically in such a way that a reverse operation and input with regard to a desired rotational speed are implementable. The mode of operation and the design of a suitable drive motor are conventional so that a detailed description thereof is dispensed with for the sake of a concise description.

According to one specific embodiment, gear unit **200** is a reduction gear unit, e.g., a planetary gear set having different planetary stages, to which a torque clutch **199** is optionally assigned. Torque clutch **199** is designed to prevent drive shaft **120** from being driven by reduction gear unit **200** during operation of handheld power tool **100**, if a torque, transferred from drive shaft **120** to reduction gear unit **200**, exceeds a threshold value which is settable by the user of handheld power tool **100**.

Moreover, reduction gear unit **200** is assigned a gearshift **260** operable via an assigned operating element **230**, so that reduction gear unit **200** is shiftable at least between a first gear having a comparatively high torque and a second gear having a comparatively low torque. During operation of handheld power tool **100**, reduction gear unit **200** is rotatably driven by drive motor **180**. Reduction gear unit **200**, which is illustratively designed as a planetary gear set, is described in detail below with reference to an enlarged section view from FIG. **2** as well as with reference to an enlarged perspective view of a detail **210** of handheld power tool **100** from FIG. **3**.

According to one specific embodiment, reduction gear unit **200** is assigned a mechanical overload protection device **290**. This overload protection device is designed to limit reduction gear unit **200** during operation of handheld power tool **100**, if a torque, transferred from drive shaft **120** to reduction gear unit **200**, exceeds a machine-specific limiting value. The machine-specific limiting value is greater than a maximum threshold value settable by the user of handheld power tool **100** via torque clutch **199**.

In the context of the present invention, a limitation of reduction gear unit **200** by overload protection device **290** is to be understood to mean that a torque, transferred from reduction gear unit **200** to drive shaft **120**, is at least reduced by overload protection device **290** in the event of a blocking of drive shaft **120**, e.g., in the event of hard screw applications, in order to thereby delimit the kinetic energy of rotation transferred from drive shaft **120** to gear housing **205** and thus tool housing **105**. In addition, the mode of operation and the design of a suitable torque clutch are conventional, so that a detailed description of torque clutch **199** is dispensed with for the sake of a concise description.

FIG. **2** shows detail **210** of handheld power tool **100** from FIG. **1**. This detail illustrates an exemplary embodiment of reduction gear unit **200** from FIG. **1**, implemented as a planetary gear set, whose gear housing **205** illustratively has a housing back section **258** and a housing front section **259**. Here, housing back section **258** may be formed by motor housing **185** from FIG. **1**, for example.

Planetary gear set **200** illustratively has three planetary stages situated in gear housing **205**: a front stage **270**, a central stage **271**, and a rear stage **272**. Front planetary stage **270** is connected to drive shaft **120** from FIG. **1** and is represented here only by an exemplary sunwheel **203**. Central planetary stage **271**, as an example, has a sunwheel **213**, at least one first and one second planetary wheels **217** and **219**, a planet carrier **214**, as well as an annulus gear **216** which is situated axially fixed, but radially movable in gear housing **205**. Planet carrier **214** forms sunwheel **203** of front planetary stage **270**; sunwheel **203** may be fastened appropriately to planet carrier **214** or may be integrally connected to it or may be designed in one piece with it. Illustratively, planet carrier **214** is situated at least sectionally within a fastening ring **209** which is rotatably fixedly connected to gear housing **205** and which has a holding contour **269**, and which fastens planet carrier **214** in gear housing **205** in an axially fixed, but radially movable manner. Rear planetary stage **272**, as an example, has a sunwheel **223**, at least one first and one second planetary wheels **227** and **229**, a planet carrier **224**, as well as an annulus gear **226** which is situated axially fixed. The latter is illustratively situated at least sectionally within an annular latching element **206** which is rotatably fixedly connected to gear housing **205**. Sunwheel **223** is, for example, formed from a pinion which is assigned to motor **180** from FIG. **1** and which drives planetary gear set **200** during operation of handheld power tool **100** from FIG. **1**. Planet carrier **224** forms sunwheel **213** of central planetary stage **271**; sunwheel **213** may be fastened appropriately to planet carrier **224** or may be integrally connected to it or may be designed in one piece with it.

According to one specific embodiment, planetary gear set **200** is shiftable via gearshift **260** from FIG. **1** between a first and a second gear, as described for FIG. **1**. For this purpose, gearshift **260** is assigned a ratchet wheel **266**, which is situated on planetary gear set **200**, is axially displaceable and radially movable, and which is rotatably fixedly connected to annulus gear **216** of central planetary stage **271** via an assigned entrainer contour **268**.

According to one specific embodiment, ratchet wheel **266** is shiftable in the axial direction of gear housing **205** from a first into a second operating position when operating element **230** from FIG. **1** is operated, the first operating position being, for example, assigned to the first gear and the second operation position being, for example, assigned to the second gear of planetary gear set **200**. In its first operating position, ratchet wheel **266** is rotatably fixedly connected to planet carrier **224** of rear planetary stage **272**, so that this planet carrier **224** and annulus gear **216** of central planetary stage **271** are rotatably fixedly connected to one another. In this way, central planetary stage **271** is deactivated, so that the first gear is activated at a comparably high torque. In its second operating position, which is shown in FIGS. **2** and **3**, ratchet wheel **266** is rotatably fixedly connected to fastening ring **209** and thus to gear housing **205** in that entrainer contour **268** of ratchet wheel **266** engages with holding contour **269** of fixing ring **209**, so that annulus gear **216** of central planetary stage **271** is rotatably fixedly fastened in gear housing **205**. In this way, central planetary stage **271** is activated, so that the second gear is activated at a comparably low torque.

Since the design and mode of operation of a planetary gear set having a gearshift are sufficiently conventional, a detailed description thereof is dispensed with for the sake of a concise description.

According to one specific embodiment, annular latching element **206**, in which annulus gear **226** of rear planetary stage **272** is at least sectionally situated, is assigned to overload protection device **290** from FIG. **1** and is illustratively axially fixedly fastened at least within predefined tolerances within or on gear housing **205** using a retainer ring **267** attached on housing front section **259** of gear housing **205**. On annulus gear **226**, at least one latching spring element **207** (as well as **407**, **409** in FIG. **4**) is situated, as an example, which is assigned to overload protection device **290**, and via which annulus gear **226** is coupled to latching element **206** and thus to gear housing **205**, as described below for FIG. **4**.

Overload protection device **290** is preferably assigned to a planetary stage which is not directly connected to either gearshift **260** or torque clutch **199** from FIG. **1**. Particularly preferably, overload protection device **290** is assigned to a planetary stage which faces motor **180** from FIG. **1**. Accordingly, overload protection device **290** in FIG. **2** is illustratively assigned to rear planetary stage **272** which faces motor **180** from FIG. **1** and is not directly connected to either gearshift **260** or to torque clutch **199** from FIG. **1**.

FIG. **3** shows detail **210** of handheld power tool **100** from FIGS. **1** and **2** in a perspective view. FIG. **3** illustrates the axial fastening of latching element **206** of overload protection device **290** on gear housing **205** using retainer ring **267**. Moreover, FIG. **3** illustrates a toothing **426** which is provided on the inner periphery of annulus gear **226** of rear planetary stage **272** and which is operatively linked to planetary wheels **227**, **229**, as well as the rotatably fixed connection of ratchet wheel **266** via its entrainer contour **268** with annulus gear **216** of central planetary stage **271** as well as to fastening ring **209** via its holding contour **269** in the second gear of handheld power tool **100** from FIG. **1**.

According to one specific embodiment, annular latching element **206** of overload protection device **290** has a latching toothing **406** on its inner periphery and radial recesses **491**, **493** (and **492** in FIG. **4**) on its outer periphery. Protrusions **481**, **483** (and **482** in FIG. **4**), which are provided on housing front section **259** of gear housing **205**, illustratively engage with these recesses so that latching element **206** is rotatably fixedly connected to gear housing **205**. Latching toothing **406** is coupled to latching spring element **207** (as well as **407**, **409** in FIG. **4**), which is assigned to overload protection device **290**, as described below for FIG. **4**.

FIG. **4** shows a section through rear planetary stage **272** of planetary gear set **200** from FIGS. **2** and **3**, an illustration of sunwheel **223** being dispensed with to simplify the figure. FIG. **4** shows another planetary wheel **428** of rear planetary stage **272** and illustrates the design of radial recesses **491**, **493** as well as of another radial recess **492** on annular latching element **206**, with which protrusions **481** and **483**, provided on gear housing **205**, as well as another protrusion **482** engage for rotatably fixed fastening.

According to one specific embodiment, on the outer periphery of annulus gear **226** of rear planetary stage **272**, at least one flattening **451** as well as at least two assigned recesses **452**, **453** are provided which have a rectangular shape, for example, and are assigned to overload protection device **290** from FIGS. **2** and **3**. Latching spring element **207** is illustratively situated in the area of flattening **451**. As an example, this latching spring element is designed in the form of a curly bracket having an approximately central detent lug **437** and rounded end areas **427**, **417** which are mounted to be freely movable in recesses **452** and **453**. Here, rounded end area **427** is acted on by a predefined spring tension in the direction of rounded end area **417** and end area **417** is acted on in the direction of end area **427**. In this way, latching spring element **207** is mounted resiliently on annulus gear **226** in the radially outward direction, so that detent lug **437** is operatively engaged with latching toothing **406** of annular latching element **206** during normal operation of handheld power tool **100** from FIG. **1**.

It is pointed out that in FIG. **4** two other latching spring elements **407**, **409** are illustratively shown which are situated in the area of flattenings and recesses which have a similar design as flattening **451** and recesses **452**, **453**. For the sake of simplicity and clarity of the figure, these flattenings and recesses have, however, not been denoted. Furthermore, it is pointed out that three latching spring elements **207**, **407**, **409** are each offset in relation to one another by an angle of 120°, for example. However, other configurations and a different number of latching spring elements are also possible. For example, only two latching spring elements may be used which are offset by an angle of 180° in relation to one another, a floating fit of annulus gear **226** in annular latching element **206** being achievable if two or more latching spring elements are used.

Moreover, it is pointed out that latching spring elements **207** which are resilient in the radially outward direction and which engage with latching toothing **406** provided on the inner periphery of annular latching element **206** are described only as an example and are replaceable by other equivalent approaches. Alternatively thereto, latching spring elements which are resilient in the radially inward direction and which engage with the latching toothing provided on the outer periphery of annulus gear **226** could, for example, be situated on the inner periphery of latching element **406**.

During normal operation of handheld power tool **100** from FIG. **1**, annulus gear **226** is rotatably fixedly connected to latching element **206**, and thus rotatably fixedly coupled to gear housing **205**, via latching spring elements **207**, **407**, **409** by detent lugs **437** of these latching spring elements engaging with latching toothing **406** of annular latching element **206**. Thus, planetary wheels **227**, **229**, **428** may rotate along toothing **426** provided on the inner periphery of annulus gear **226**, if these are driven by sunwheel **223** from FIGS. **2** and **3**, a torque which is generated by drive motor **180** from FIG. **1** and reduced by planetary gear set **200** being transferred to drive shaft **120** from FIG. **1**.

For the case of an at least partial blocking of drive shaft **120** from FIG. **1**, e.g., in the event of hard screw applications, this torque is at least partially transferred back from drive shaft **120** to reduction gear unit **200** and thus to gear housing **205** and tool housing **105** from FIG. **1**. If, in the process, the back-transferred torque exceeds a machine-specific limiting value which is, for example, predefinable by a selected stiffness or spring force of latching spring elements **207**, **407**, **409** and/or the design of latching toothing **406**, among other things, detent lugs **437** slide out of the operative engagement with latching toothing **406** due to an elastic deformation of latching spring elements **207**, **407**, **409**.

In the case of such a resilient deformation, detent lugs **437** of latching spring elements **207**, **407**, **409** are pressed against their spring force radially inward in the direction of assigned flattenings **451**, so that each of rounded end areas **417** or **427** are pressed outward, viewed in the tangential direction of annulus gear **226**, as a function of a particular direction of rotation of annulus gear **226**. In this way, annulus gear **226** may rotate in gear housing **205** around a longitudinal axis assigned to drive shaft **120** from FIG. **1** at least until the back-transferred torque exceeds the machine-specific limiting value again. In the context of the present invention, this is referred to as a limitation of planetary gear set **200**, as described above.

What is claimed is:

1. A handheld power tool, comprising:

a gear housing;

a motor;

a drive shaft; and

a reduction gear unit, drivable by the motor for driving the drive shaft, the reduction gear unit being situated in the gear housing and being shiftable via a gearshift at least between a first gear having a comparatively high torque and a second gear having a comparatively low torque, wherein the reduction gear unit is assigned a mechanical overload protection device which is designed to limit the reduction gear unit during operation of the handheld power tool, if a torque transferred from the drive shaft to the reduction gear unit exceeds a machine-specific limiting value,

wherein the reduction gear unit is assigned a torque clutch which is designed to prevent the drive shaft from being driven by the reduction gear unit during operation of the handheld power tool, if a torque, transferred from the drive shaft to the reduction gear unit, exceeds a threshold value which is settable by a user of the handheld power tool, the machine-specific limiting value being greater than a maximum threshold value settable by the user of the handheld power tool,

wherein the reduction gear unit is designed in the form of a planetary gear set having at least three planetary stages, the overload protection device being assigned to one of the planetary stages which is not directly connected to either the gearshift or to the torque clutch.

2. The handheld power tool as recited in claim **1**, wherein the planetary stage to which the overload protection device is assigned faces the motor.

3. The handheld power tool as recited in claim **1**, wherein the planetary stage to which the overload protection device is assigned has an annulus gear which is coupled to the gear housing via at least one latching spring element.

4. The handheld power tool as recited in claim **3**, wherein the annulus gear is rotatably fixedly situated in the gear housing until the machine-specific limiting value is reached for the case that a torque is transferred from the drive shaft to the reduction gear unit and is able to rotate in the gear housing around a longitudinal axis assigned to the drive shaft if the machine-specific limiting value is exceeded.

5. The handheld power tool as recited in claim **3**, wherein the at least one latching spring element is situated resiliently on the annulus gear in a radially outward direction.

6. The handheld power tool as recited in claim **3**, wherein the at least one latching spring element acts resiliently against the annulus gear in a radially inward direction.

7. The handheld power tool as recited in claim **3**, wherein a latching element, which is rotatably fixedly connected to the gear housing, is provided in a radial direction between the annulus gear and the gear housing.

8. A mechanical overload protection device for a handheld power tool comprising:

a reduction gear unit, drivable by a motor, for driving a drive shaft, the reduction gear unit being situated in a gear housing and being shiftable via a gearshift at least between a first gear having a comparatively high torque and a second gear having a comparatively low torque, wherein the overload protection device is designed to limit the reduction gear unit during operation of the handheld power tool, if a torque transferred from the drive shaft to the reduction gear unit exceeds a machine-specific limiting value,

wherein the reduction gear unit is assigned a torque clutch which is designed to prevent the drive shaft from being driven by the reduction gear unit during operation of the handheld power tool, if a torque, transferred from the drive shaft to the reduction gear unit, exceeds a threshold value which is settable by a user of the handheld power tool, the machine-specific limiting value being greater than a maximum threshold value settable by the user of the handheld power tool, wherein the reduction gear unit is designed in the form of a planetary gear set having at least three planetary stages, the overload protection device being assigned to one of the planetary stages which is not directly connected to either the gearshift or to the torque clutch.

* * * * *